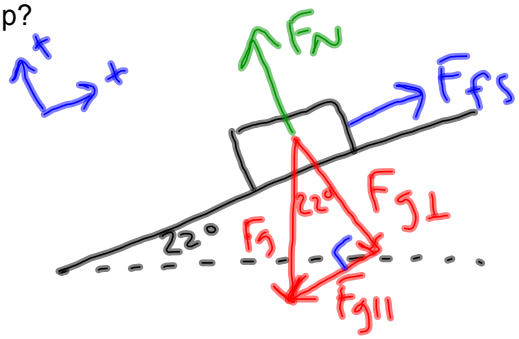
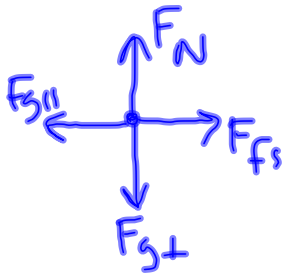
Final Exam Review 4th Block 1.5.12

A 5.5 kg suitcase is at rest on a ramp that is angled 22.0 degrees above the horizontal. What is the coefficient of friction between the suitcase and the surface of the ramp?





$$\mu_s = \frac{F_{fs}}{F_N}$$

$$= \frac{20.2\ N}{49.98\ N}$$

$$= 0.404$$

$$\Sigma F_{11} = \emptyset$$

$$F_{fs} - F_{g11} = \emptyset$$

$$F_{fs} = F_{g11}$$

$$= F_g \sin(22°)$$

$$= m a_g \sin(22°)$$

$$= (5.5\ kg)(9.8\ m/s^2)\sin(22°)$$

$$= 20.2\ N$$

$$\Sigma F_\perp = \emptyset$$

$$F_N - F_{g\perp} = \emptyset$$

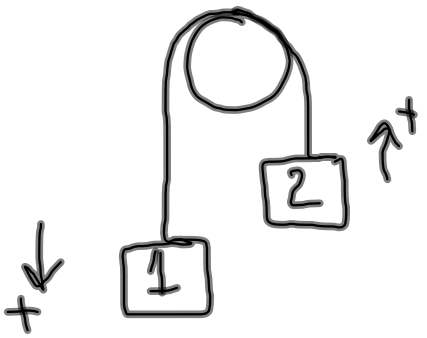
$$F_N = F_{g\perp}$$

$$= m a_g \cos(22°)$$

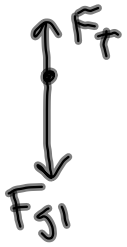
$$= (5.5\ kg)(9.8\ m/s^2)\cos(22°)$$

$$= 49.98\ N$$

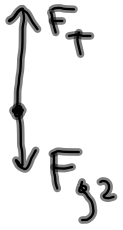
Two masses are hanging by a rope passed over a pulley. The mass on the left is 7.89 kg, and the mass on the right is 6.87 kg. What is the acceleration of the block on the right?



FBD 1:



FBD 2:



$F_{g_1} = m_1 a_g$

$\Sigma F_1 = m_1 a$ $F_{g2} = m_2 a_g$ $\Sigma F_2 = m_2 a$

$F_{g1} - F_T = m_1 a$ $F_T - F_{g2} = m_2 a$

$m_1 a_g - m_2 a_g - m_2 a = m_1 a$ $F_T = F_{g2} + m_2 a$

$= m_2 a_g + m_2 a$

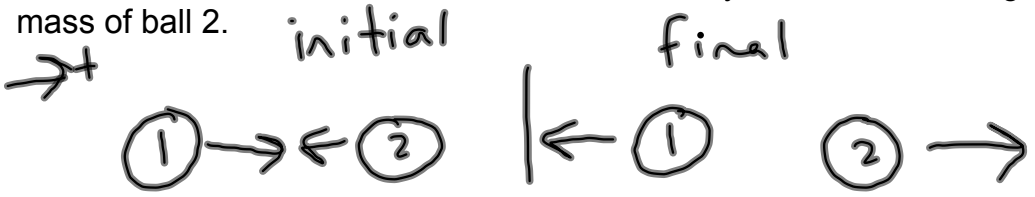
$a(m_1 + m_2) = a_g(m_1 - m_2)$

$$a = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) a_g$$

$$= \left(\frac{7.89\,kg - 6.87\,kg}{7.89\,kg + 6.87\,kg}\right)(9.8\,m/s^2)$$

$$= 0.677\,m/s^2$$

Ball 1 has a mass of 10 kg and is moving initially at 10 m/s to the right. After it collides with ball 2, it has a velocity of 3 m/s to the left. Ball 2 is moving initially at 17 m/s to the left, and after it collides with ball 1 it has a velocity of 22 m/s to the right. Find the mass of ball 2.



$$m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = m_1\bar{v}_{1f} + m_2\bar{v}_{2f}$$

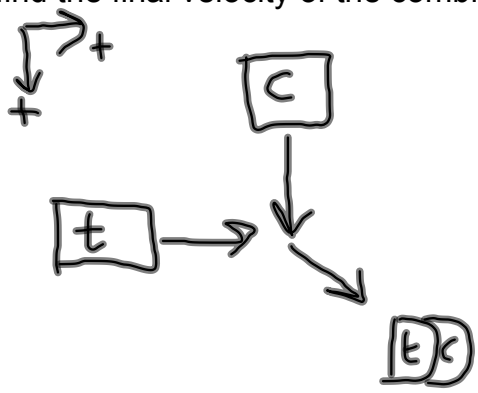
$$m_2(\bar{v}_{2i} - \bar{v}_{2f}) = m_1(\bar{v}_{1f} - \bar{v}_{1i})$$

$$m = m_1\left(\frac{\bar{v}_{1f} - \bar{v}_{1i}}{\bar{v}_{2i} - \bar{v}_{2f}}\right)$$

$$= (10\text{ kg})\left[\frac{(-3\text{ m/s}) - (10\text{ m/s})}{(-17\text{ m/s}) - (22\text{ m/s})}\right]$$

$$= 3.33\text{ kg}$$

A 1800 kg car is traveling south with a velocity of 30 m/s and a 2200 kg truck is traveling east with a velocity of 21 m/s. If the car and truck collide and stick together, find the final velocity of the combined mass.



x-direction: $\bar{P}_x = \bar{P}_{cx}^{\,0} + \bar{P}_{tx} = m_t \bar{v}_{tx}$

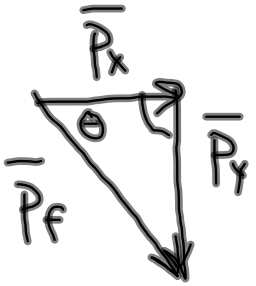
$= (2200\ kg)(21\ m/s)$

$= 46200\ kg \cdot m/s$

y-direction: $\bar{P}_y = P_{cy} + P_{ty}^{\,0} = m_c \bar{v}_{cy}$

$= (1800\ kg)(30\ m/s)$

$= 54000\ kg \cdot m/s$



$\bar{P}_f = 71066\ kg \cdot m/s$ @ 49.5° S of E

$\bar{P}_f = (m_c + m_t)\bar{v}_f$

$\bar{v}_f = 17.8\ m/s$ @ 49.5° S of E